Questioned Documents Unit (QDU)
Procedures for Conducting Writing Medium Examinations

1 Scope

These procedures will be used by a forensic document examiner to examine ink, pencil, or other writing mediums usually observed on a writing surface. Examination requests include determining the type of writing instrument used to prepare an item, consistency between two or more writing mediums, backdating, and insertion/alteration issues.

2 Equipment/Materials/Reagents

- Fostec 150 watt tungsten halogen light, or comparable equipment
- Laboratory Supplies Co., Inc. 30 watt transmitted light box, or comparable equipment
- Hand magnifier (minimum magnification, 4X)
- Leica stereomicroscope (minimum magnification, 6.3X), or comparable equipment
- Keyence VHX-2000E Digital Microscope, or comparable equipment
- Foster and Freeman Video Spectral Comparator (VSC), or comparable equipment
- ChemImage Hyper Spectral Imager (HSI) Examiner 200 QD, or comparable equipment
- Reference materials

3 Standards and Controls

Not Applicable.

4 Sampling

Not Applicable.

5 Procedures

Only nondestructive examinations of ink, pencil, and other writing mediums will be conducted in the QDU.

5.1 Examine the specimen(s) visually for physical characteristics using lighting and magnification sufficient to allow fine detail to be distinguished. The VSC (for performance and verification frequency, refer to the VSC Performance and Maintenance logbook nearest the instruments), HSI, (for performance and verification frequency, refer to the HSI Examiner 200QD Performance and Maintenance logbook nearest the instrument), or digital microscope (for performance and verification frequency, refer to the Keyence Maintenance and Performance logbook nearest the instrument) may be useful. Note, at a minimum, the class characteristics of the writing medium(s) and any differentiation of the writing mediums. Physical characteristics include:

- Color
- Consistency of the writing medium
- Writing instrument characteristics as described below

5.1.1 Class characteristics of ball point pen writing include:

- Striations may be visible within the written stroke.
- Defects in the writing line may include small dot-like deposits of ink known as gooping.
- Indentations down the center of the ink stroke may be visible.
- Ink is paste-like with high viscosity.
- There may be skipping or short gaps in the ink stroke.
- The ball size may be medium, fine, or extra fine.

5.1.2 Class characteristics of porous-tip pen writing include:

- A broad, solid, or ribbon-like stroke may be observed.
- Indentations in the ink line are not usually observed.
- The aqueous ink may saturate the paper with slight bleeding into the paper fibers.
- Subtle line quality characteristics, such as hesitations and pen lifts may be harder to detect.
- The size of the porous tip may be broad, fine, or very fine.

5.1.3 Class characteristics of roller ball writing include:

- Ink stroke is similar to the porous-tip pen, but the ball tends to emboss the paper.
- The aqueous ink may saturate the paper with slight bleeding into adjacent fibers.
- Ink flow-back can often be seen at the end of a stroke.
- Characteristics of skipping and gooping are absent.

5.1.4 Class characteristics of gel pen writing include:

- An outline of darker ink along the edges of the ink stroke (i.e., "the squeegee effect"). This is a result of the high-viscosity ink being pushed by the ball to the outer edges of the ink stroke.
- The ink does not tend to bleed into the paper fibers as much as with water-

based roller ball or porous-tipped pens.
- Indentations may be visible.
- A broad range of ink colors, including metallic, are available.

5.1.5 Class characteristics of fountain or nib pen writing include:
- Pronounced darker double track within the stroke on flexible points.
- Shading may be recognized with flexible point pens by the gradual increase in the width of the stroke due to the pressure of the pen, particularly on the downstrokes.
- Variation in ink density may be observed.

5.1.6 Class characteristics of encased graphite, encased color, and mechanical pencil writing include:
- The written stroke is not a solid line, but may vary in intensity of color.
- There may be microscopic gaps and clumps of graphite.
- Graphite flakes adhere to the paper surface wedged between the paper fibers.
- The graphite does not penetrate the paper fibers as ink does.

5.1.7 If the writing mediums to be compared are not consistent in class characteristics, this indicates exclusion. Discontinue this procedure and report accordingly.

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5.3 Using the VSC, HSI, or comparable equipment, examine the items by using various filters while applying a range of wavelengths of light as necessary (i.e., visible light, UV, and/or IR).

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5.3.3 Note any differentiation of the writing mediums in question and, if using the VSC, HSI, or digital microscope, print out the representative images with the filter and light settings.

5.4 If special photographic techniques are necessary, transfer the items to the Operational Projects Unit (OPU).

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5.7 Documents requiring only chemical ink composition comparisons will be referred to the FBI Laboratory's Chemistry Unit.

5.8 Make notations in the examination records. Include all notes, data, and observations used to support your findings or conclusions. Include any information gathered, printouts, photographs, overlays, or drawings of any optical, physical, or microscopic characteristics observed during the examination process.

5.9 Conclusions

- **Corresponds in Optical Characteristics -** When the comparison of two or more writing mediums reveals correspondence in optical characteristics (i.e., significant agreement in all observable aspects of the results with no significant, reproducible, inexplicable differences), it may be concluded that the writing mediums are optically similar within the limitations of this methodology. The possibility that other analytical techniques might be able to differentiate the samples must be considered. This conclusion does not eliminate the possibility that the writing medium samples being compared are from different manufacturing batches or writing instruments.

- **No Conclusion/No Determination -** No determination can be reached whether or not the writing mediums originate from a common origin due to factors that significantly limit meaningful examinations. This opinion requires explanation of the limiting factors.

- **May Not Share a Common Origin** When the comparison of two or more writing mediums reveals correspondence in general class characteristics (i.e., color and type of writing instrument) but inexplicable differences are found at some level of the analysis, it may be concluded that the writing mediums are

not similar at that level of analysis and that the results of the examination indicate the samples may not be from a common origin. This opinion requires explanation of limiting factors which preclude an elimination.

- **Elimination -** A determination that the two inks do not have a common origin based on significant, reproducible, or inexplicable differences in class characteristics.

6 Calculations

Not Applicable.

7 Measurement Uncertainty

Not Applicable.

8 Limitations

The following factors could affect the examination process and/or the results rendered:
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- Factors that interfere with the writing process, such as blotting wet ink.
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- Prior destructive forensic examinations such as latent print processing.
- Lack of a sufficient quantity of questioned and/or known items.

9 Safety

Standard precautions should be followed for the handling of chemical and biological materials. Examiners/analysts may refer to the *FBI Laboratory Safety Manual* for additional guidance. Chemical and biological materials that are hazardous or potentially hazardous will be maintained and examined in specifically designated areas within the QDU space.

10 References

FBI Laboratory Safety Manual

ASTM E 1422, "Standard Guide for Test Methods for Forensic Writing Ink Comparison," *Annual Book of ASTM Standards*, Vol 14.02.

ASTM E 1789, "Standard Guide for Writing Ink Examination," *Annual Book of ASTM Standards*, Vol 14.02.

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Crown, D.A., Crim, D., and Brunelle, R. L., "The Parameters of Ballpen Ink Examinations," *Journal of Forensic Sciences*, 1976. (380)

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Hilton, Ordway, *Scientific Examination of Questioned Documents Revised Edition*, Elsevier Science Publishing Co., New York, NY. 1982.

Osborn, Albert S., *Questioned Documents Second Edition*, Nelson-Hall Co., Chicago, IL. 1929.

Seaman Kelly, J., and Lindblom, B., Editors, *Scientific Examination of Questioned Documents, Second Edition*, CRC Press, Boca Raton, FL. 2006.

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Rev. #	Issue Date	History
5	03/01/18	2 Equipment/Materials/Reagents, seventh bullet, deleted 100, added "200" for HSI. 5.1 added (for performance and verification frequency, refer to the VSC Performance and Maintenance logbook nearest the instruments)" "(for performance and verification frequency, refer to the HSI Examiner 200QD Performance and Maintenance logbook nearest the instrument) "(for performance and verification frequency, refer to the Keyence Performance logbook nearest the instrument)"
6	09/26/19	Section 5.1 added "Maintenance and" before the word Performance. Section 5.3 deleted "i.e." and added "e.g." Section 5.3.1 added "as necessary." Section 5.3.2 added "as necessary." Section 5.3.2.2 added "and/or other inks." Section 5.4 deleted "Forensic Imaging Unit (FIU)" and added "Operational Projects Unit (OPU). Section 5.6 added "brand and possibly." Section 5.7 added "only." Section 5.9 first bullet, added "optically" in front of similar. Section 5.9, third bullet, added "When the comparisons of two or more writing mediums reveals correspondence in general class characteristics (i.e., color and type of writing instrument) but", added "some", added "similar", added "which preclude an elimination", deleted "any" and "the same." Section 5.9 fourth bullet, added "reproducible, or inexplicable."

Approval Redacted - Signatures on File

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Quality Manager — Date: 09/24/2019